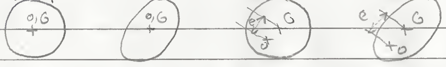
6_ Out of roundness

* Centre of rotation & centre of geometry:

- Polar coordinates:



Round — No eccentricity

Not round — No ecc.

Round — Ecc. exists

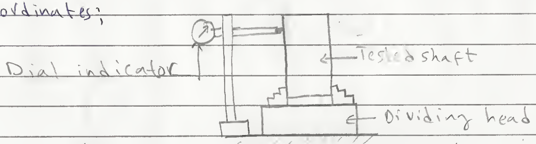
Not round — Ecc. exists

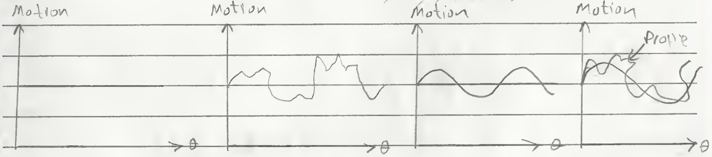
(G) Centre of geometry (At which areas are symmetric about)

(O) Centre of rotation (At which rotation occurs about)

$O \not\equiv G \Rightarrow$ Eccentricity exists

- Cartizien coordinates;

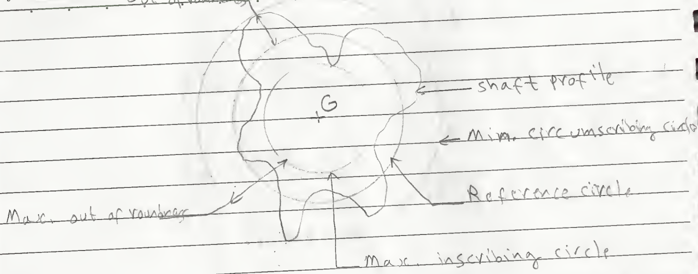




Round, Ecc. = 0 — Not round, Ecc. = 0 — Round, Ecc. ≠ 0 — Not round, Ecc. ≠ 0

* - Out of roundness (Error of circularity): It is the radial distance between the minimum circumscribing circle and the max inscribing circle, which contain the profile of the shaft. The ref. circle is the circle which best represents the shaft profile. This circle may be obtained by applying the least square method. The max. out of roundness will be the radial distance between circumscribing & inscribing circle.

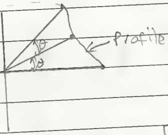
Subject. Out of roundness   39:   Date.

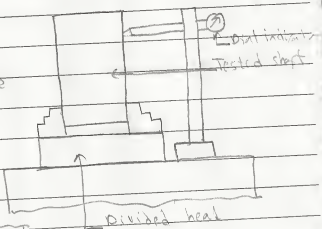


* Experimental techniques;

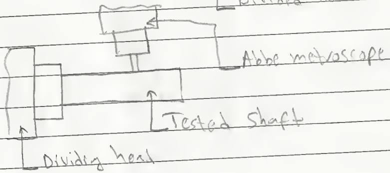
1-

θ_i	R_i
θ	ǀ
2θ	ǀ
Uniform	ǀ

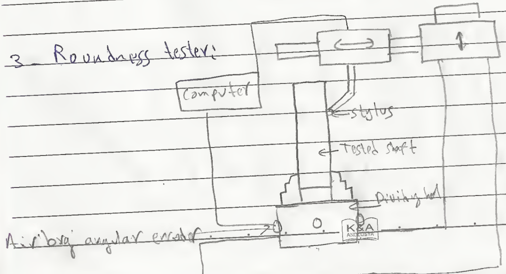




2-



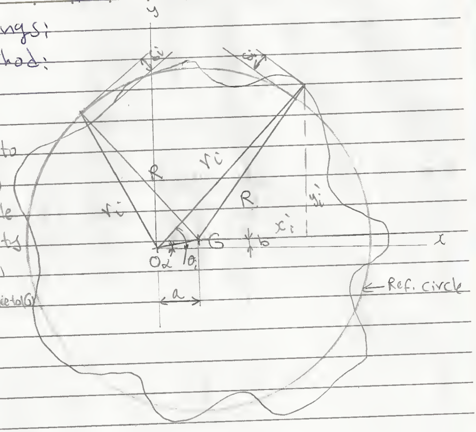
3- Roundness tester;



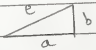
* Analysis of readings:

1- Analytrical method:

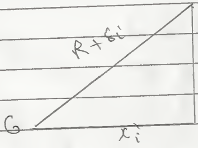
- (δ_i) Roundness error
- (r_i) Reading relative to centre of rotation (O)
- (R) Radius of ref. circle
- (α) Angle of eccentricity
- (θ_i) Angle of point (i)
- (x_i', y_i') Coordinates of Pt(i) relative to (G)
- (G) Centre of circles



- $R = \frac{\sum r_i}{n}$



- $\alpha = \tan^{-1}\left(\frac{b}{a}\right)$
- $e = \sqrt{a^2 + b^2}$



- $(R + \delta_i)^2 = x_i'^2 + y_i'^2$

$$\delta_i = \frac{x_i'^2 + y_i'^2 - R^2}{2R}$$

- Using least square method; $a = \frac{2 \sum x_i}{n}$

$$b = \frac{2 \sum y_i}{n}$$

θ_i	r_i	$x_i = r_i \cos\theta_i$	$y_i = r_i \sin\theta_i$	$x_i' = x_i - a$	$y_i' = y_i - a$	$\delta_i = \frac{x_i'^2 + y_i'^2 - R^2}{2R}$

$\sum r \Downarrow R$ $\quad$ $\sum x \Downarrow a$ $\quad$ $\sum y \Downarrow b \Rightarrow G = (a, b)$

Max. roundness = δ_{max} + δ_{min}